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Title: ARTSN: An Automated Real-Time Spacecraft Navigation System

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An effort is underway at the Jet Propulsion Laboratory (JPL) to design a filter to automate the deep space navigation process. This project, the Automated Real-Time Spacecraft Navigation (ARTSN) filter task, is part of the Deep Space Network (DSN) Advanced Technology Program.

The prototype is currently a FORTRAN77 package operating on an HP-9000/700 series workstation running HP-UX 9.05. This will be converted to C, which will be the maintained operational version. The processing tasks required can be divided into four groups; read a measurement, integrate the spacecraft state to the current measurement time, compute the observable based on the integrated state, and incorporate the measurement information into the state using an EKF. This filter processes radiometric data (currently only two-way differenced-range Doppler) collected using the DSN. The dynamical (force) models currently include point mass gravitational terms for all planets, Sun and Moon, solar radiation pressure, finite maneuvers, and attitude maintenance activity modeled quadratically. In addition, observable errors due to the troposphere are included. Further data types, force models and observable models will be included to enhance the accuracy of the models and capability of the package. The heart of ARTSN is a current-state continuous-discrete extended Kalman filter. This is a departure from the epoch state/pseudo-epoch state formulation used currently for deep space navigation, but is necessary to mesh with the data driven nature of real time processing. The filter is implemented in the standard form, except for the use of the general covariance update formula for an arbitrary gain matrix to enhance the numerical properties of the process. Further numerical enhancement using UD and/or SRIF forms of the Kalman filter will be implemented.

Results will be presented for the simulated data used to test the implementation at various stages of development, along with results from processing actual mission data.

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